International Journal of Business
Management & Research (IJBMR)
ISSN (P): 2249–6920; ISSN (E): 2249–8036
Vol. 9, Issue 5, Oct 2019, 1–12
© TJPRC Pvt. Ltd.

TRANS STELLAR
•Journal Publications •Research Consultancy

AMELIORATING PRODUCTIVITY IN LUBRICANT INDUSTRY USING INDUSTRIAL ENGINEERING TOOLS

RISHABH PANDEY

Nityanand Society, Ambakhad, Khambhat, Gujarat, India

ABSTRACT

In a manufacturing or service industry, it is important to constantly improve, in order to sustain oneself in today's increasingly competitive world. There is a growth in the customer demands, since the technology has taken leaps of development. Numerous business improvement methodologies are acquired by organizations to improve business performance. The main aim is to study the current capacity, scrutinize it to find areas of improvement and make an upgradation to meet the forecasted growth in demand. Therefore, this study helps to recognize the bottlenecks and by taking help of various work-study & time study methods, and other tools & techniques of industrial engineering, which are one of the most influential & most effective methodologies for abolishing delays associated with the working process in the production area of a lubricant manufacturing industry. And henceforth, this paper concludes with the suggestions to take necessary action for improving the overall performance of a system with the complete affirmation of large annual profit margins. This prescriptive paper proposes authentic solutions & results in increment in the production of the industry.

KEYWORDS: Lubricant Industry, Work-Study Method, Time-Study Method & Improvement in Productivity

Received: Jun 15, 2019; **Accepted:** Jul 05, 2019; **Published:** Sep 06, 2019; **Paper Id.:** IJBMROCT20191

Original Article

INTRODUCTION

The market size of lubricants will prompt in future, due to ascending demand of automobile. Usually, an organic substance, introduced to minimize friction between surfaces which are in mutual contact, is known as a lubricant. It may also have the function of transporting foreign particles, transmitting forces and cooling the surfaces. According to a market research report, it is found that globally, the market size of lubricants was valued at USD 128.51 billion in the year 2018. [1]Therefore, to sustain oneself in the market, it is obligatory to ensure the proper utilization of capitals. Monetary growth of an industry largely depends on minimizing slog and ameliorating productivity. Initially, we should understand the term production in order to minimize excess work and improve productivity. Any operation or procedure developed to transfer a set of input into a specified set of output in proper quality and quantity, thus attaining the objectives of the industry is known as production. It helps to manufacture products by the transformation of raw materials. The production process for the lubricant industry is shown in figure.1. The ratio between the output of wealth and the input of resources used in the process of production is known as productivity.

$$\text{Productivity} = \frac{\text{OUTPUT}}{\text{INPUT}}$$

Productivity measurement is paramount for manufacturing or service industry. For enhancing more profit by using the same kind of resources, productivity improvement is one of the major issues nowadays. Increment in productivity also helps to gratify customer, reduce time and capital to produce, develop and deliver products.

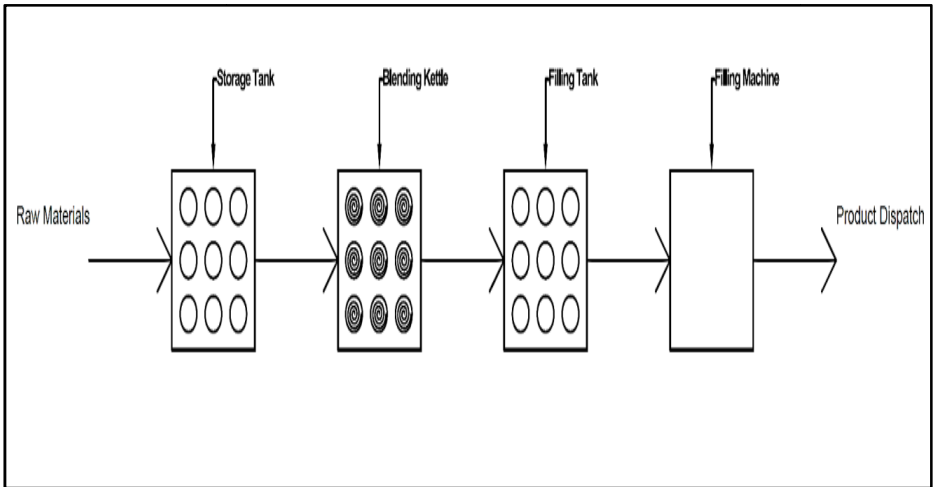

Figure 1: Manufacturing Process for Lubricant Industry.

Nowadays, productivity is also confused with terms like effectiveness and efficiency. Also, these terms are wrongly considered synonyms of productivity. Efficiency and Effectiveness are two different terms such that efficiency indicates how well the resources are utilized to accomplish a result. On the other hand, effectiveness refers to the degree of accomplishing the objectives. By sorting of elimination, repairing of ineffective process, optimizing the system, simplifying the method, reducing variation, maximizing turnout up quality or responsiveness and reducing set-up time are some tools for improving productivity. In this study, manpower working on the filling machines is replaced by implementing innovative methods, in order to ameliorate productivity. The replaced manpower is effectively assigned, wherever there is a necessity. Improvement of productivity through work-study method is essential for increasing profit as well as proper utilization of labours of an industry.

Storage Tank (ST)

Storage tanks are cylindrical in shape with a fixed roof and perpendicular to the ground with flat bottoms. These tanks are used to hold base oil, additives, etcetera for further manufacturing of lubricants. Fundamentally, there are two types of storage tanks—Above-Ground Storage Tank (AST) and Under-Ground Storage Tank (UST). The focused industry is using 41 storage tanks (above ground) with a wide span of 25KL to 1000KL. Usually, there are many environmental regulations applied to the design and operation of storage tanks, depending upon the nature of the fluid which is contained within.

Blending Kettle (BK)

A blending kettle is a vessel used for mixing two heterogeneous liquids with intent to make it more homogeneous. In total, there are 24 blending kettles with a mixing range of 2KL to 300KL. Raw materials like—base oil, additives and chemicals are all mixed together in blending kettles to make a more efficient, reliable and better lubricant for automotive. The recipe is given by the Quality Check Department for blending the respective product.

Filling Tank (FT)

A homogeneous mixture of base oil, additives and chemicals after blending, are kept in large tanks known as “Filling Tanks”. There are 26 filling tanks with a wide range of 10KL to 20KL. These tanks keep the lubricant before proffering it to the filling machines for filling into the oil containers.

Filling Machine (FM)

These machines are designed for filling different types of lubricants like—engine oil, brake fluid, gear oil, clutch oil, power steering oil, Adblue (Diesel Exhaust Fluid) etc. into the containers. These machines are used to fill a container, a pouch or a barrel, depending upon the manufactured product. In total, there are 19 filling machines in the plant. Out of 19 filling machines, 4 are Fast Filling Machines (FFM) which are totally automatic and doesn't require any workforce for manual work except a machine operator and one extra personnel. Programmable Logical Control (PLC) based control system is used to control the machine automatically. The rest 15 machines are manual or semi-automatic; these machines require ample manpower for their functioning.

The filling machines and fast filling machines utilize sensors like—proximity sensor, beam sensor, photoelectric sensor. After the oil is filled into the container, the product gets ready to dispatch so, it is concluded that filling section is a penultimate section. Filling Machines and Fast Filling Machines are designed to fill the container from a range of 40ml up to 210 Ltr. The volumetric filling principle is used to fill the oil pouch and containers. On the contrary, weighing filling principle is used to fill the barrels for industrial use.

LITERATURE REVIEW

Work study and Time study is a business efficiency technique. After the introduction of these techniques, work-study has enhanced in improving the work methods, while time study leads in the direction of establishing standard times. Figure 2 helps in understanding, how work-study helps in ameliorating productivity. The integrated approach towards work system amelioration is known as Methods Engineering, which today is applied for the use of industries as well as service organizations, including schools, banks and hospitals.

Observing a consistent system of work done in the industry, a work-study investigation is done in order to attain the best possible utilization of all 3-M's (men, material, and machines) which is available in the plant at present. In this research, the method of work-study is used for productivity improvement in needful assembly lines. By performing time-study and critical analysis, reduction of work content and proper utilization of manpower is achieved.

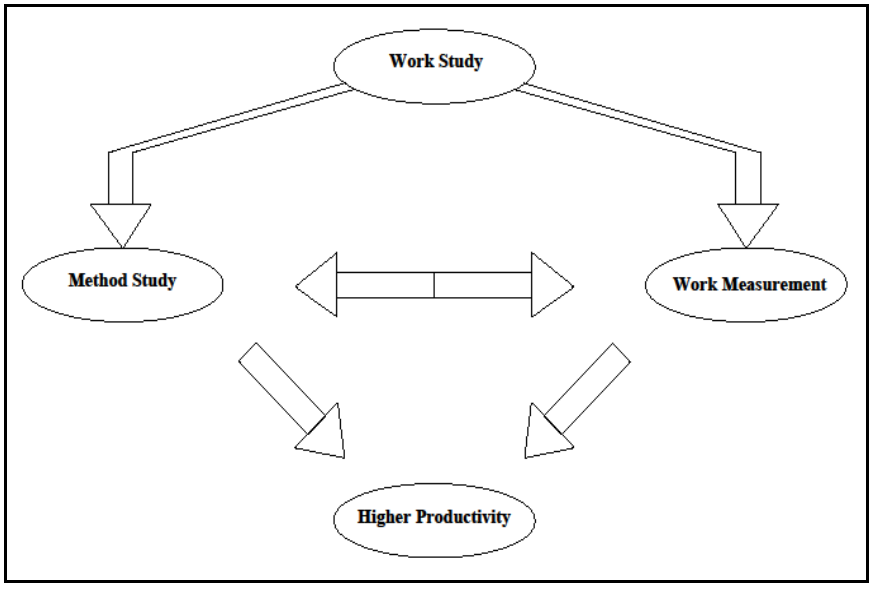

Figure 2: The Figure Shows How Work-Study Helps in Ameliorating Productivity.

RESEARCH METHODOLOGY

In this study, a lubricant manufacturing industry is selected at first. After that, the filling sections are selected for performing the case study. It is observed that out of 19 filling machines, for instance, some FFM'shave the capacity of filling 6,600 containers/ per hour (approx.). But due to some reasons (discussed later in the study), it was found that the hourly production of such FFM's is only 4,000–4,500 container/ per hour (approx.). After observing all the operations, existing problems are identified by using the critical questioning technique. Some new methods and processes are recommendedfor selected filling machines, to utilize the resources further leading to productivity improvement. This study aims at eliminating various—time - delays, paperwork, old methods which leads to substandard productivity.

CASE STUDY

Manpower Observation

With the help of work-study method, a methodical collection of the data can be done. Total number of the workforce working in three shifts (i.e. morning, afternoon, night) are observed and mentioned in table 1.

Table 1: Observation Table of Existing Total Workforce

Code	Range of Filling Machine *(in litres)*	Workforce					
		Morning Shift (1)		Afternoon Shift (2)		Night Shift (3)	
		Operator	Worker	Operator	Worker	Operator	Worker
FM - 01	0.175 - 1.2	1	8	1	8	1	8
FM - 03	0.9 - 6.5	1	6	1	6	1	6
FM - 04	0.5 - 6.5	1	6	1	6	1	6
FM - 06	0.1 - 5.0	1	2	1	2	1	2
FM - 07	0.1 - 5.0	1	2	1	2	1	2
FM - 11	6.0 - 20.0	2	2	2	2	2	2
FM - 12	6.0 - 20.0	1	3	1	3	N/A	N/A
FM -13	200.00 - 210.00	1	3	1	3	1	3
FM - 14	200.00 - 210.00	1	3	1	3	1	3
FM - 15	200.00 - 210.00	1	3	1	3	1	3
FM - 16	200.00 - 210.00	1	3	1	3	1	3
FM - 17	200.00 - 210.00	1	3	1	3	1	3
FM - 18	200.00 - 210.00	1	3	1	3	1	3
FM - 19	20.00 - 210.00	2	4	2	4	2	3
FM -20	20.00 - 210.00	2	4	2	4	2	3
FM - 21	10.00 - 55.00	1	1	1	1	1	1
FFM - 01	2.5; 3.0 ; 5.0	3	8	3	8	3	8
FFM - 02	0.5 ; 0.9 ; 1.0	3	6	3	6	3	6
FFM - 03	0.9 - 1.0	1	9	1	9	N/A	N/A
FFM - 04	0.9 - 1.0	2	6	2	6	N/A	N/A
Pouch - 1	0.04	N/A	1	N/A	1	N/A	1
Pouch - 2	0.04	N/A	1	N/A	1	N/A	1
Pouch - 3	1	1	5	1	5	1	5
Pouch - 4	0.1 - 0.3	1	9	1	9	1	9
Manual - 1	10.0 - 55.0	1	2	1	2	1	2
Leaky Rework	-	1	4	1	4	1	4
Coolant	-	1	3	1	3	1	3
Slab Charging	-	N/A	2	N/A	2	N/A	2

Table 1: Contd.,							
BK - 16	-	1	1	1	1	1	1
BK - 20	-	1	1	1	1	1	1
Sampling	-	N/A	1	N/A	1	N/A	1
Additive Decanting	-	N/A	3	N/A	3	N/A	3
Flushing Oil Charging & Decanting	-	N/A	2	N/A	2	N/A	2
Total	**0.04*l*- 210.00*l***	**155**		**155**		**131**	

***N/A = Not Applicable/ Machine is not in use for production.**

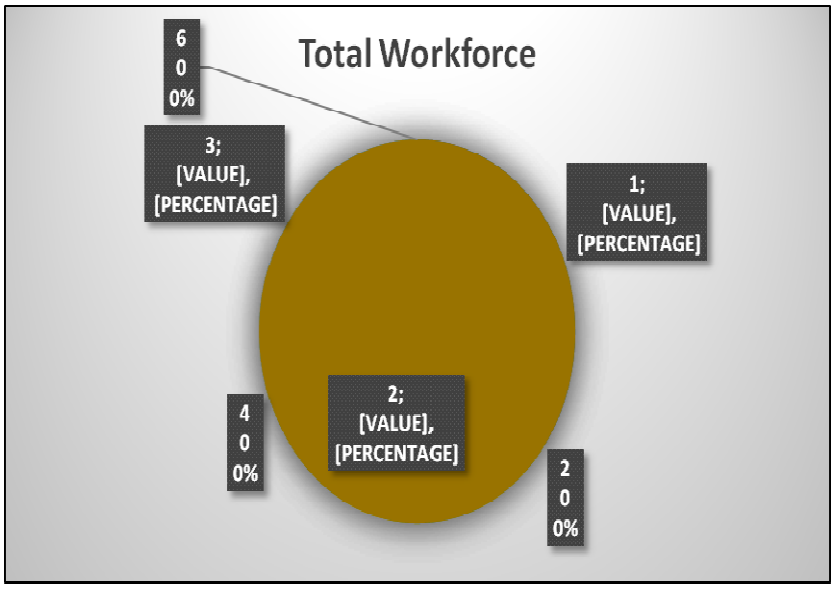

Figure 3: Pie Chart Showing % Contribution of Manpower

Pie Diagram

After discovering the total workforce from all three shifts, a pie chart is generated from the table: 1 to get a graphical representation of the numbers.

Docket Method

It came into notice that while performing the method of work-study, the executive is using paperwork for providing batch numbers, packaging date, weight, MRP etc. to the machine operators. These numbers are given to the machine operator for printing customer information on the containers and buckets of the manufactured products. The paper with the information is known as “Docket”. It was noticed that this method can be improved, as it compromises with the confidentiality of the industry by increasing lots of paperwork. Also, this process has more chances for human error. Many a time, the executive writes the wrong data (i.e. batch number, MRP, packaging date, etc.) on the docket, which leads to error in the printing and adequate time is gobbled up for rectifying the mistake. The working procedure of the docket method is shown in figure 4.

The block diagram shows that docket is fetched everywhere by the labour for recognition of batch number. Also, when verifying the 1st filling sample, labour fetches the docket with a filled sample to the Quality Check Department.

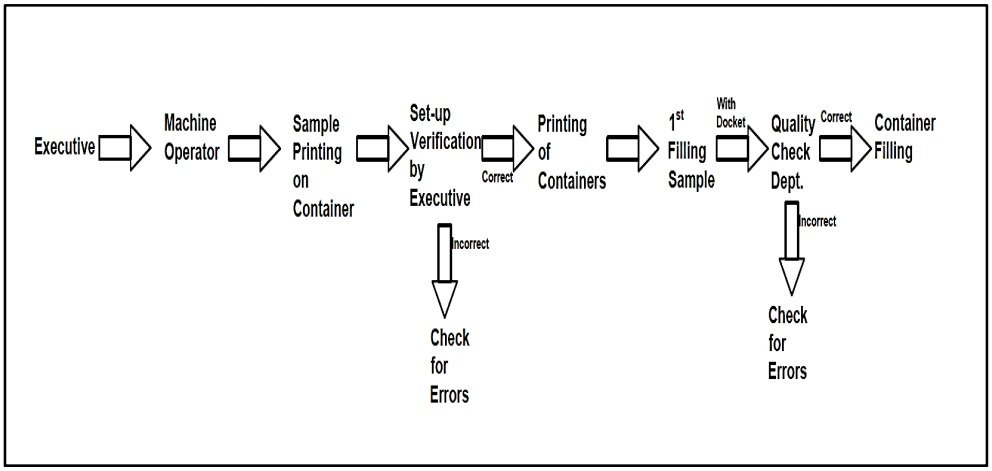

Figure 4: Working Procedure of Existing Docket Method.

Filling Machine

Machines play a pivotal role in all the industries, and they have replaced the prerequisite for labour work. Punctuality in machinery transport ensures that a business meets its objectives by keeping the employees motivated and customers satisfied. The machines also minimize the cost of production and increase the revenue of a business. By executing work-study and time-study, it was discovered that some filling machines namely-FM-03, FM-12, FM-19, FM-20, FFM-04 can be upgraded by adopting modern tools and techniques. The drawbacks of the respective machines are explained below.

- **Filling Machine–03:** The filling potential of FM-03lies between 0.9*l*—6.5*l* with a workforce of 6 labours and 1 operator. The machine is semi-automatically equipped with 4 nozzles. The maintained air pressure is 5.5 kg/cm^2. Two labours are employed for manually placing and tightening the cap of the filled container which leads to delay in the filling process. The bottleneck of this machine is to complete a single job, two labours are employed. One labour can be used at some other necessary area. Some proposals are discussed in the paper, which will help in ameliorating the productivity of the machine.

- **Filling Machine–12:** The filling potential of FM-12 lies between 6.0*l*—20.0*l* with a workforce of 3 labours and 1 operator. The machine is semi-automatically equipped with 6 nozzles. The maintained air pressure is 5.5 kg/cm^2. One labour distributes vacant buckets with the help of conveyor from the packaging section (on the first floor) of the plant. So, the drawback of this machine which came into observation is—when a bucket bag is emptied, it takes time for opening a new bucket bag and placing the buckets on its position for further distribution of empty buckets. In the meantime, production is halted until the vacant buckets are supplied. However, this filling machine is used only in two shifts (i.e. morning and afternoon).

- **Filling Machine–19 & 20:** The filling potential of FM-19 and FM-20lies between 20.0*l*—210.0*l* with a workforce of 4 labours and 2 operators. The machines are semi-automatically equipped with 1 nozzle (each). The maintained air pressure is 5.5 kg/cm^2. These two filling machines are used for filling "Diesel Exhaust Fluid" (DEF) into the buckets and barrels. The DEF is made by using dirty water as one of the raw material. The problem with the plant set-up is—the barrel flushing is done manually and offline. This leads to squandering of energy and time of the industry. A modern method is suggested for solving the drawback of this plant.

- **Fast Filling Machine–04:** The filling potential of FFM-04 lies between 0.9*l*—1.0 with a workforce of 6 labours and 2 operators. The machine is fully-automatic equipped with 12 nozzles. The maintained air pressure is 5.5 kg/cm^2. The machine has the ability to fill 6,600 containers in one hour, but it's impotent to achieve this. The container has three stickers (front, back and side). The containers are manufactured by blow moulding technique on the same floor of the machine. With the help of conveyor, the container is dispatched to the packaging floor (first floor) for adhering side label which contains cash coupon QR code. Out of 6 labours, 3 labours are employed in the packaging area for adhering and distributing the container on the ground floor again. The perceived issue with this automatic machine is conveyor, and manpower is used unnecessarily just for adhering a QR code. Some proposals are discussed further in this paper for saving the energy and time of the manpower as well as the machine.

RECOMMENDATIONS

It is advised to follow a few solutions that can be promptly implemented so as toincrease the production level, some techniques to minimize the delays have been provided below:

Docket Method

We have already discussed the existing docket practice. Now, to solve the issue of human error and confidentiality, it is suggested to use a display monitor nearby PLC system of the filling machine. Since the draft is already saved within the computer of the executive, so it would be easy to fill the entries like—batch number, MRP, date, weight etc. By taking succour of SAP, entries will be uploaded into the system database. However, SAP can be accessed by every department so the labour doesn't have to carry a reference for the on-going production batch. The working of the proposed Docket Method is shown in figure.4. Also, the display monitor can be linked with the printer via programming which will minimize the efforts of manually entering data into printing devices by the labour. The data will endure confidential in the system's database, comparatively; data is less secure with the paperwork. For future reference and statistics, data can be fetched from the database of the system.

Filling Machine

There are few bottlenecks in the filling machines — FM-03, FM-12, FM-19, FM-20, FFM-04 which were noticed during work-study. Some recommendations are given for improving their production—

- **FM-03:** Two labours are employed forplacing and tightening the cap on the containers. The suggested method is to set-up either an automatic cap placing machine oran automatic cap tightening machine. This will reduce the work of one labour from the machine, and that labour can be used somewhere necessary.
- **FM-12:** In the packaging area, only one labour is employed for unpacking and distributing the buckets from bucket bag. So, it is suggested that one labour should be employed to unpack the buckets from bucket bag and one labour should distribute the empty buckets through the conveyor. This will minimize the delay in the production of the machine, as buckets will be bestowed in a continuous manner.
- **FM-19 & FM-20:** These two filling machines are installed in another region of the plant. The Diesel Exhaust Fluid is filled in buckets and barrels with the help of these filling machines. The drawback of this

plant is—flushing is done manually and also offline. Workers have to move the barrels for flushing. To solve this issue, we can upgrade the manual flushing to online flushing. So, there is no wastage of energy.

- **FFM-04:** Three labours are employed for adhering to a side sticker (cash coupon QR Code) on the containers. The suggested method is to design the QR Code into front or back label of the container. The label should be designed accordingly, so that the coupon shouldn't take much space. Labelling of front and back label is done on the same floor as that of machine; also there is no need of conveyor to transfer containers on the packaging floor. This will reduce three labours from themachine; these three labours can be employed somewhere necessary.

Manpower Observation

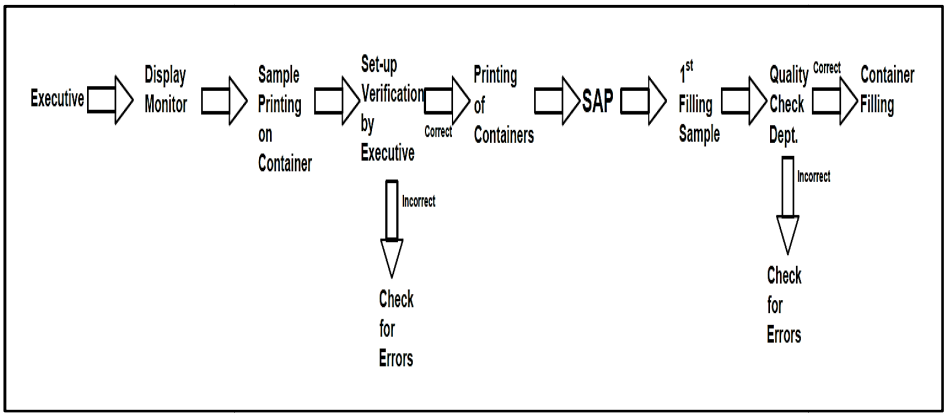

Figure 5: Working of Proposed Docket Method.

Table 2: Observation Table of Proposed Total Workforce

Code	Range of Filling Machine *(in litres)*	Workforce					
		Morning Shift (1)		Afternoon Shift (2)		Night Shift (3)	
		Operator	Worker	Operator	Worker	Operator	Worker
FM - 01	0.175 - 1.2	1	8	1	8	1	8
FM - 03	0.9 - 6.5	1	5	1	5	1	5
FM - 04	0.5 - 6.5	1	6	1	6	1	6
FM - 06	0.1 - 5.0	1	2	1	2	1	2
FM - 07	0.1 - 5.0	1	2	1	2	1	2
FM - 11	6.0 - 20.0	2	2	2	2	2	2
FM - 12	6.0 - 20.0	1	3	1	3	N/A	N/A
FM -13	200.00 - 210.00	1	3	1	3	1	3
FM - 14	200.00 - 210.00	1	3	1	3	1	3
FM - 15	200.00 - 210.00	1	3	1	3	1	3
FM - 16	200.00 - 210.00	1	3	1	3	1	3
FM - 17	200.00 - 210.00	1	3	1	3	1	3
FM - 18	200.00 - 210.00	1	3	1	3	1	3
FM - 19	20.00 - 210.00	1	4	1	4	1	3
FM -20	20.00 - 210.00	1	4	1	4	1	3
FM - 21	10.00 - 55.00	1	1	1	1	1	1
FFM - 01	2.5; 3.0 ; 5.0	3	8	3	8	3	8
FFM - 02	0.5 ; 0.9 ; 1.0	3	6	3	6	3	6
FFM - 03	0.9 - 1.0	1	9	1	9	N/A	N/A

Table 2: Contd.,							
FFM - 04	0.9 - 1.0	2	3	2	3	N/A	N/A
Pouch - 1	0.04	N/A	1	N/A	1	N/A	1
Pouch - 2	0.04	N/A	1	N/A	1	N/A	1
Pouch - 3	1	1	5	1	5	1	5
Pouch - 4	0.1 - 0.3	1	9	1	9	1	9
Manual - 1	10.0 - 55.0	1	2	1	2	1	2
Leaky Rework	-	1	4	1	4	1	4
Coolant	-	1	3	1	3	1	3
Slab Charging	-	N/A	2	N/A	2	N/A	2
BK - 16	-	1	1	1	1	1	1
BK - 20	-	1	1	1	1	1	1
Sampling	-	N/A	1	N/A	1	N/A	1
Additive Decanting	-	N/A	3	N/A	3	N/A	3
Flushing Oil Charging & Decanting	-	N/A	2	N/A	2	N/A	2
Total	**0.04*l*- 210.00*l***	**149**		**149**		**128**	

***N/A = Not Applicable/ Machine is not in use for production.**

Table 3

Shifts	Before Proposal	After Proposal
Morning Shift	155	149
Evening Shift	155	149
Night Shift	131	128
Total Manpower	**441**	**426**

Money Calculation

f the estimated salary of one labour is taken as Rs.300 ($4.28), the annual profit for the company after reducing the workforce will be—

The money spent monthly on 15 extra workers is= 15×30×Rs. 300 (for each worker) = Rs. 135,000/- ($1,926)

So, money spent annually will be= Rs. 135,000×12 = Rs. 1620, 000/- ($23,112)

Therefore, saving of Rs. 1620, 000/- ($23,112) can be done annually if the recommendations are followed.

RESULTS AND DISCUSSIONS

The present production workforce of the plant is 441 labours. After following recommendations, the workforce is reduced by 15 labours and left with just 426 labours. The working hours for this company are 8 hours. In total, there are 19 filling machines in the plant. The suggested recommendations helped in increasing the productivity of the machines as well as generating the revenue for the company. The proposed method helps to decrease the cost expenses up to Rs. 1620, 000/- ($23,112) annually, with a reduction of work content.

CONCLUSIONS AND RECOMMENDATION

Productivity improvement is an important issue in the lubricant manufacturing industry. The revenue of the lubricantindustry largely depends on productivity improvement. This study shows the way of finding bottlenecks of production process and operations. By implementing work study and time study, new effective processes for particular operations have been established.

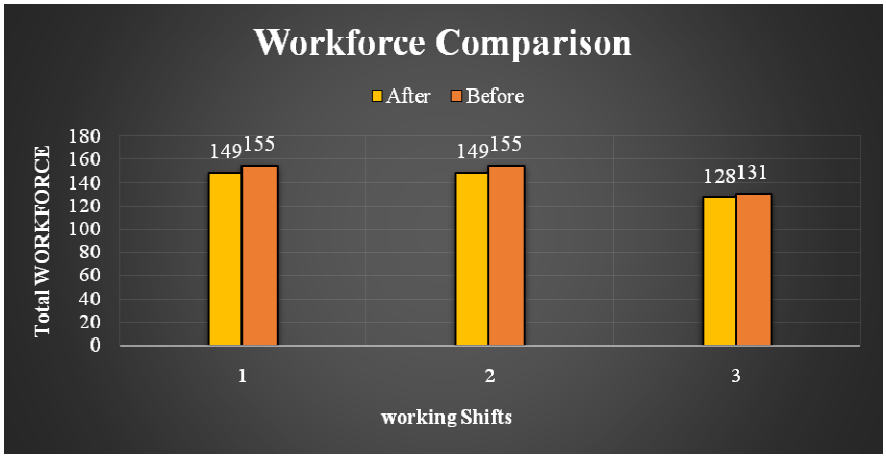

Figure 5: Comparison of Workforce in Different Shifts

Especially, this study shows the improvement of productivity in an assembly line of the lubricant manufacturing industry. This study shows the productivity improvement by reduction of work content. Further research could be done by using a combination of lean and work-study technique.

REFERENCES

1. *Region and Segment Forecast 2019–2025, "Lubricants Market Size, Share & Trends Analysis Report", Grand View Research, May 2019.*
2. *Akshay D. Wankhade, Dr. Achal S. Shahare, "Productivity Improvement by Optimum Utilization of Plant Layout: ACase Study", International Research Journal of Engineering and Technology (IRJET), Vol. 4 Issue 6, pp. 1501–1505, June-2017.*
3. *Rosly Othman, Wong Sze Voon, "Logistics Performance Analysis and Improvement: A Case Study of a Building Materials Company", Global Business and Management Research: An International Journal (GBMR), Vol. 10 No.1, pp. 266–279, 2018.*
4. *Ibidunni, O. S., Falola, H. O., Ibidunni, A. S., & Olokundun, A. M. (2014). Effects of Human Resource Waste on Productivity in Nigeria. International Journal of Human Resource Management and Research (IJHRMR), 4(3), 47–56.*
5. *B. Naveen, Dr. T. Ramesh Babu, "Productivity Improvement in Manufacturing Industry using Industrial Engineering Tools", IOSR Journal of Mechanical and Civil Engineering (IOSR-JCME), Vol. 6, pp. 11–18.*
6. *Xiang Li, "Operations Management of Logistics and Supply Chain: Issues and Directions", Discrete Dynamics in Nature and Society, Vol. 2014, pp. 1–8, June-2014.*
7. *Kumari, J. A., & Rao, P. (2017). Effect of Temperature on Soil Enzyme Urease Activity-Productivity.*
8. *Amal S Das, P V Gopinadhan, "Productivity Improvement Using Industrial Engineering Tools — Case Study of a Typical Spinning Mill", International Journal of Engineering Development and Research (IJEDR), Vol. 4 Issue 3, pp. 911–916, 2016.*
9. *Md. Abdul Moktadir, Sobur Ahmed, Fatema-Tuj-Zohra, Razia Sultana, "Productivity Improvement by Work Study Technique: A Case on Leather Products Industry of Bangladesh", Industrial Engineering & Management, OMICS International, Vol. 6 Issue 1, pp. 1–11, June 2017.*
10. *Dr. M. P. Singh, Hemant Yadav, "Improvement in Process Industries by Using Work Study Methods: A Case Study", International Journal of Mechanical Engineering and Technology (IJMET), Vol. 7 Issue 3, pp. 426–436, May–June 2016.*

11. *Antara Shantilal Rathod, Rajat Ganesh Jadhav, Amey Balasaheb Babar, "An Overview of Method Study and Study of Different Recording Techniques", International Journal of Science and Research (IJSR), Vol. 5 Issue 8, pp. 1484–1491, August 2016.*
12. *Neeraj Kumar Sharma, "Enhance Productivity Using Method Study in Sugar Industry", International Journal of Mechanical and Industrial Technology, Vol. 4 Issue 2, pp. 35–37, October 2016–March 2017.*

AUTHOR PROFILE

Rishabh Pandey is a fourth – year Mechanical Engineering student. He has published two papers in the **International Journals** namely — "**International Journal of Engineering Research & Generic Science (IJERGS)**" & "**International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC)**". He is also awarded with a silver medal for his scores in NPTEL examination by IIT – Roorkee.